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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/024,272	12/18/2001	Bernard Delperier	BDL-371XX	4935

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EXAMINER	
MARKHAM, WESLEY D	

ART UNIT	PAPER NUMBER
1762	

DATE MAILED: 03/16/2004

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary	Application No.	Applicant(s)	
	10/024,272	DELPERIER ET AL.	
	Examiner	Art Unit	
	Wesley D Markham	1762	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☐ Responsive to communication(s) filed on _____.

2a)☐ This action is **FINAL**. 2b)☒ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *1-21* is/are pending in the application.

4a) Of the above claim(s) *9-12,18 and 19* is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *1-8,13-17,20 and 21* is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☒ The specification is objected to by the Examiner.

10)☒ The drawing(s) filed on *18 December 2001* is/are: a)☐ accepted or b)☒ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☒ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☒ All b)☐ Some * c)☐ None of:

1.☒ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☒ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☒ Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08) Paper No(s)/Mail Date *12/18/01*.
4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____ .
5) ☐ Notice of Informal Patent Application (PTO-152)
6) ☐ Other: _____.

DETAILED ACTION

Election/Restrictions

1. Restriction to one of the following inventions is required under 35 U.S.C. 121:

   I. Claims 1 – 8, 13 – 17, 20, and 21, drawn to a method of densifying porous substrates of hollow shape by chemical vapor infiltration (CVI), classified in class 427, subclass 237.

   II. Claims 9 – 12, 18, and 19, drawn to an installation for densifying hollow-shaped porous substrate(s), classified in class 118, subclass 728.

2. The inventions are distinct, each from the other because of the following reasons: Inventions I and II are related as process and apparatus for its practice, respectively. The inventions are distinct if it can be shown that either: (1) the process as claimed can be practiced by another materially different apparatus or by hand, or (2) the apparatus as claimed can be used to practice another and materially different process. (MPEP § 806.05(e)). In this case, the process as claimed can be practiced by another materially different apparatus, such as an apparatus in which the means for admitting and/or evacuating gas are located in the side wall of the enclosure, not the end walls, or in which the means for admitting and evacuating gas are both located at the same end wall, not first and second end walls opposite each other. Additionally, the apparatus as claimed can be used to practice another and materially different process, such as (1) an etching process, (2) a CVD process, not a CVI process, (3) a process in which the substrate is not densified, or (4) a process in which the substrate is not porous.

3. Because these inventions are distinct for the reasons given above and have acquired a separate status in the art as shown by their different classification and recognized divergent subject matter, restriction for examination purposes as indicated is proper.
4. During a telephone conversation with Mr. Charles Gagnebin on 3/2/2004, a provisional election was made with traverse to prosecute the invention of Group I, Claims 1 – 8, 13 – 17, 20, and 21. Affirmation of this election must be made by the applicant in replying to this Office Action. Claims 9 – 12, 18, and 19 are withdrawn from further consideration by the examiner, 37 CFR 1.142(b), as being drawn to a non-elected invention.
5. Applicant is reminded that upon the cancellation of claims to a non-elected invention, the inventorship must be amended in compliance with 37 CFR 1.48(b) if one or more of the currently named inventors is no longer an inventor of at least one claim remaining in the application. Any amendment of inventorship must be accompanied by a request under 37 CFR 1.48(b) and by the fee required under 37 CFR 1.17(i).

Response to Amendment

6. Acknowledgement is made of the preliminary amendment filed by the applicant on 12/18/2001, in which Claims 3 – 6, 8, and 12 were amended, and Claims 13 – 21 were added. This amendment was taken into consideration when making the restriction requirement set forth above. Claims 1 – 21 are currently pending in U.S. Application Serial No. 10/024,272.

Priority

7. Receipt is acknowledged of papers submitted under 35 U.S.C. 119(a)-(d) (i.e., the certified copy of priority document FRANCE 00 16615, filed on 12/19/2000), which papers have been placed of record in the file.

Information Disclosure Statement

8. The IDS filed by the applicant on 12/18/2001 is acknowledged, and the documents listed thereon have been considered by the examiner as indicated on the attached copy of the PTO-1449 form.

Oath/Declaration

9. The examiner notes that the declaration states that priority document FRANCE 00 16615 was filed on 12/19/2001. However, the aforementioned document was actually filed on 12/19/2000.

Drawings

10. The formal drawings (9 sheets, 13 figures) filed on 12/18/2001 have been received by the Office.
11. The drawings are objected to because Figures 10, 12, and 13 and dark and blurry, thereby making the drawings (and what they intend to depict) unclear.

12. Figures 11 – 13 should be designated by a legend such as --Prior Art-- because only that which is old is illustrated (see, for example, page 6, lines 14 – 18, of the applicant's specification, which indicates that the CVI installation of Figure 11 is prior art, and the photographs in Figures 12 and 13 show samples treated using the prior art installation). See MPEP § 608.02(g).

13. The drawings are objected to as failing to comply with 37 CFR 1.84(p)(5) because they include the following reference sign(s) not mentioned in the description: "18_3" in Figure 2; "130_2" in Figure 3; "S'_1" and "S'_2" in Figure 5; "326_1" in Figure 7; and "$322'_1$", "$322'_2$", "$331'_1$" and "$324'_1$" in Figure 11. A proposed drawing correction, corrected drawings, or amendment to the specification to add the reference sign(s) in the description, are required in reply to the Office action to avoid abandonment of the application. The objection to the drawings will not be held in abeyance.

14. The drawings are objected to as failing to comply with 37 CFR 1.84(p)(5) because they do not include the following reference sign(s) mentioned in the description: "214", "214'", and "214'" (page 12, lines 24 – 25); "330_2" (page 13, lines 23 and 27); "24" (page 14, line 7); "$332'_1$", "$321'_1$", and "$330'_2$" (page 16). A proposed drawing correction or corrected drawings are required in reply to the Office action to avoid abandonment of the application. The objection to the drawings will not be held in abeyance.

Specification

15. Applicant is reminded of the proper language and format for an abstract of the disclosure. The abstract should be in narrative form and generally limited to a single paragraph on a separate sheet within the range of 50 to 150 words. It is important that the abstract not exceed 150 words in length since the space provided for the abstract on the computer tape used by the printer is limited. The form and legal phraseology often used in patent claims, such as "means" and "said," should be avoided. The abstract should describe the disclosure sufficiently to assist readers in deciding whether there is a need for consulting the full patent text for details.

16. The disclosure is objected to because of the following informalities:

- Page 2, line 29: The U.S. Patent No. (i.e., 5,904,956) provided by the applicant appears to contain a typographical error and should read 5,904,957.
- Page 11, line 24: It appears that the reference number "103_2" is a typographical error and should read "130_2" in order to correctly correspond to Figure 3.
- Page 16, line 10: It appears that the reference number "322_1" is a typographical error and should read "$322'_1$" in order to correctly correspond to Figure 11.

Appropriate correction is required.

Claim Observations

17. The examiner notes that the word "and" appears to be missing from the beginning of the last step recited in both Claims 20 and 21.

18. Regarding independent Claim 1, the examiner has reasonably interpreted "porous substrates of hollow shape" and "hollow-shaped substrate" to require that the substrate(s) have a concave inside surface that is continuous, i.e., that does not have any holes, other than those due to the porous nature of the substrate (see page 1, lines 16 – 19, of the specification).

19. Regarding independent Claim 1, the examiner has reasonably interpreted "pressure equilibrium" to require that there be no pressure gradient between the inside and outside faces of the substrate(s) (see page 10, lines 20 – 22, of the specification).

20. Regarding independent Claim 1, the examiner has broadly but reasonably interpreted "part of the reactive gas flow" and "a fraction of the total admitted gas flow" to be inclusive of any part and fraction of the gas flow, including substantially all of (i.e., ~100%, or a fraction of 1/1) the gas flow.

Claim Rejections - 35 USC § 103

21. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

22. This application currently names joint inventors. In considering patentability of the claims under 35 U.S.C. 103(a), the examiner presumes that the subject matter of the various claims was commonly owned at the time any inventions covered therein were made absent any evidence to the contrary. Applicant is advised of the obligation under 37 CFR 1.56 to point out the inventor and invention dates of each claim that was not commonly owned at the time a later invention was made in order for the examiner to consider the applicability of 35 U.S.C. 103(c) and potential 35 U.S.C. 102(e), (f) or (g) prior art under 35 U.S.C. 103(a).

23. Claims 1 – 8, 13 – 17, 20, and 21 are rejected under 35 U.S.C. 103(a) as being unpatentable over Sirtl et al. (USPN 4,194,028) in view of Hammond et al. (USPN 5,911,824), Yamamoto (JP 2000-247779 A), Chaudhuri et al. (USPN 4,741,925), and the applicant's admitted prior art (AAPA).

24. Regarding independent **Claim 1** (from which Claims 2 – 8, 13 – 17, 20, and 21 depend), Sirtl et al. teaches a process of coating a graphite crucible "5" (i.e., a substrate of a hollow shape) by chemical vapor deposition (CVD), the method comprising disposing at least one substrate (i.e., the graphite crucible "5") in a reactor (i.e., an enclosure) and admitting a reactive gas into the enclosure through gas inlet "8", the method being characterized in that part of the reactive gas flow admitted into the enclosure is guided by tooling, specifically the lower part of gas inlet "8", to the inside of the volume defined by the concave inside face of the hollow-shaped graphite crucible "5" so that the protective layer of, for example, silicon

carbide, is uniformly deposited on the inside of the crucible (Abstract, Figure, Col.1, lines 59 – 68, Col.2, lines 1 – 68, Col.3, lines 1 – 7, and Col.4, lines 10 – 54). Sirtl et al. does not explicitly teach that the graphite crucible is "porous". However, graphite in general, and graphite crucibles specifically, are inherently porous. For support of this position, see Hammond et al. (Abstract, Col.1, lines 10 – 20, and Col.2, lines 36 – 41). Therefore, the hollow substrate taught by Sirtl et al. (i.e., the graphite crucible) is inherently "porous" to some extent, as required by the claims. Additionally, Sirtl et al. does not explicitly teach that the graphite crucible is densified by CVI. Specifically, Sirtl et al. teaches that the crucible is coated with a protective layer of silicon carbide by CVD (Abstract, Col.4, lines 10 – 54). The protective layer is intended to protect the crucible from attack by molten silicon in a silicon pulling process according to Czochralski (Abstract, Col.1, lines 5 – 14 and 54 – 58), and the protective layer should be absolutely pore-free to do so (Col.3, lines 61 – 65). Hammond et al. teaches that, in the art of protecting a graphite crucible from molten processing materials (i.e., a process analogous to that of Sirtl et al.), a protective material can either be deposited on the surface as a coating, or more preferably, impregnated into the surface of the graphite crucible in order to seal the open porosity in the graphite (i.e., to densify the crucible) (Abstract, Col.1, lines 4 – 20, and Col.4, lines 4 – 11). Yamamoto teaches that a carbonaceous crucible used in a Czochralski process (i.e., a crucible analogous to that of Sirtl et al.'s) can be densified by using CVI to deposit silicon carbide into the pores of the crucible (Abstract, paragraphs [0001] – [0003], [0010], [0012], [0013], [0016], and [0020] –

[0024]). Yamamoto teaches that CVI (as opposed to CVD) can be achieved by carefully controlling the process conditions to insure that the process gas permeates into the pores of the substrate (paragraphs [0020] – [0023]). The CVI-treated crucible of Yamamoto has a long activity life and is excellent in endurance (paragraph [0037]). Therefore, it would have been obvious to one of ordinary skill in the art to densify the graphite crucible (i.e., the hollow porous substrate) of Sirtl et al. with silicon carbide by CVI (as opposed to simply depositing silicon carbide on the surface of the crucible by CVD) by controlling the process conditions in/of the reactor of Sirtl et al. to insure that the process gas permeates into the pores of the substrate with the reasonable expectation of successfully and advantageously producing a highly-durable crucible that has a long activity life (as taught by Yamamoto). One of ordinary skill in the art would have reasonably expected this CVI process to be superior to an ordinary CVD process because Hammond et al. teaches that it is preferable to impregnate a graphite crucible, rather than simply coat the crucible, in order to seal the open porosity in the graphite. Additionally, Sirtl et al. does not explicitly teach that the concave inside face of the crucible is swept in full by a fraction of the total admitted gas flow. However, it is the objective of Sirtl et al. to uniformly treat the inside of the crucible (Col.4, lines 50 – 54). Chaudhuri et al. teaches that, by directing a tube into a crucible, the tube terminating about 2" above the bottom of the crucible and having a plurality of holes located around the periphery of the tube, gas flowing out of the tube and into the crucible is directed toward the bottom and inside walls of the crucible, thereby insuring that the entire

inner surface of the crucible is uniformly treated (Col.1, lines 19 – 55). Therefore, it would have been obvious to one of ordinary skill in the art to use a tube such as the one taught by Chaudhuri et al. as the gas inlet "8" in the process of Sirtl et al. with the reasonable expectation of successfully and advantageously insuring that the entire inner surface of the crucible is uniformly treated with the gas (i.e., insuring that the concave inside face is swept in full by a fraction of the total admitted gas flow), as desired by Sirtl et al., due to the structure of the gas introduction tube. Additionally, the combination of Sirtl et al., Hammond et al., Yamamoto, and Chaudhuri et al. does not explicitly teach that the CVI is performed at "pressure equilibrium". However, none of the aforementioned references teaches or suggests that a pressure gradient between the two sides of the crucible is present during the process. Further, the AAPA teaches that densifying porous substrates by CVI at pressure equilibrium is a well-known process ("Background of the invention" section, page 2, lines 3 – 4, of the applicant's specification). Therefore, it would have been obvious to one of ordinary skill in the art to perform the process of the combination of Sirtl et al., Hammond et al., Yamamoto, and Chaudhuri et al. at pressure equilibrium with the reasonable expectation of (1) success, as densifying porous substrates by CVI at pressure equilibrium is a well-known process, and (2) advantageously carrying out the process at a single reactor pressure without pressure variations or gradients, as desired by Sirtl et al. (Col.4, lines 41 – 42). Regarding **Claim 2**, the combination of Sirtl et al., Hammond et al., Yamamoto, Chaudhuri et al., and the AAPA also reasonably suggests distributing the reactive gas flow admitted into the

enclosure towards each face (i.e., the inner and outer face) of the substrate placed in the enclosure. Specifically, the aforementioned combination of references teaches that the reactive gas flow is directed to the entire inner surface (i.e., the concave surface) of the graphite crucible in the silicon carbide CVI process. Additionally, the AAPA teaches that it was known in the art at the time of the applicant's invention to support hollow substrates in a CVI apparatus in a manner such that both sides of the substrates are exposed and not shielded or covered (see Figure 11, page 6, lines 14 – 15, and page 16 of the applicant's specification, which describes Figure 11). It would have been obvious to one of ordinary skill in the art to support the hollow substrate of the combination of Sirtl et al., Hammond et al., Yamamoto, Chaudhuri et al., and the AAPA in a CVI reactor in the manner taught by the AAPA with the reasonable expectation of (1) success, as the AAPA teaches that hollow substrates can be supported in such a manner, and (2) advantageously eliminating the complex rotating substrate susceptor / support taught by Sirtl et al., thereby simplifying the process. By supporting the crucible of Sirtl et al. in this manner and introducing the reactive gas towards the concave inside face, the gas would inherently flow by (i.e., be distributed toward) the outer face of the crucible as well on its way to being exhausted from the reactor by gas outlet "9" (see Figure of Sirtl et al.). Regarding **Claims 3, 4, 13, and 14**, the combination of Sirtl et al., Hammond et al., Yamamoto, Chaudhuri et al., and the AAPA also teaches that the fraction of the total reactive gas flow sweeping over a face of the or each substrate placed in the enclosure is not less than 5% (Claims 3 and 13), particularly not less than 10% (Claims 4 and 14).

Specifically, by placing the reactive gas introduction pipe directly into the crucible and flowing the gas towards the entire inner surface of the crucible (as taught by Chaudhuri et al. – see the discussion of Claim 1 above), about 100% of the total reactive gas flow sweeps over the inner face of the crucible of Sirtl et al. (i.e., because that is where all the reactive gas is introduced). Regarding **Claims 5, 15, 16, and 17**, the combination of Sirtl et al., Hammond et al., Yamamoto, Chaudhuri et al., and the AAPA also reasonably suggests densifying a plurality of substrates simultaneously, the substrates being placed inside the enclosure in alignment in the general flow direction of the gas through the enclosure. Specifically, Sirtl et al. teaches that a single substrate is placed inside the enclosure in alignment with the general flow direction of the gas through the enclosure (see Figure of Sirtl et al., in which the gas is introduced at the top of the reactor and exhausted from the bottom of the reactor, and the substrate is aligned with this flow). The AAPA teaches that it was known in the art at the time of the applicant's invention to support a plurality of hollow substrates in a CVI apparatus in alignment with the flow of gas through the apparatus (see Figure 11, page 6, lines 14 – 15, and page 16 of the applicant's specification, which describes Figure 11). Therefore, it would have been obvious to one of ordinary skill in the art to simultaneously densify a plurality of crucibles using the process of the combination of Sirtl et al., Hammond et al., Yamamoto, Chaudhuri et al., and the AAPA, the crucibles being placed inside an apparatus in alignment in the general flow direction of the reactive gas through the apparatus (as taught by the AAPA), with the reasonable expectation of successfully and advantageously

increasing the process throughput (i.e., by treating multiple crucibles at the same time). Regarding **Claims 6 – 8**, the combination of Sirtl et al., Hammond et al., Yamamoto, Chaudhuri et al., and the AAPA also teaches that the gas flow guidance is provided by a wall portion which penetrates part of the way into the volume defined by the concave inside face of the or each substrate (Claim 6), particularly a cylindrical wall portion that guides the gas flow to the vicinity of the end wall of the or each substrate (Claim 7), and/or by passages formed through a body housed inside the volume defined by the concave inside face of the or each substrate (Claim 8). Specifically, the gas flow guidance tube of Chaudhuri et al. having a ½" outside diameter (i.e., a "cylindrical wall portion"), extending into and terminating about 2" above the bottom of the crucible (i.e., the vicinity of the end wall of the crucible), and having a plurality of holes (i.e., passages) located around the periphery of the tube used to introduce gas into the crucible and toward the bottom and inside walls of the crucible (see Col.1, lines 22 – 55 of Chaudhuri et al. and the discussion of Claim 1 above) meets the applicant's claimed gas flow guidance limitations required by Claims 6 – 8. As **Claim 20** simply recites a combination of the limitations previously recited in Claims 4 – 7, the combination of Sirtl et al., Hammond et al., Yamamoto, Chaudhuri et al., and the AAPA teaches all the limitations of this claim for the reasons set forth in the discussion of Claims 4, 5, 6, and 7 above. As **Claim 21** simply recites a combination of the limitations previously recited in Claims 4 – 8, the combination of Sirtl et al., Hammond et al., Yamamoto, Chaudhuri et al., and the

AAPA teaches all the limitations of this claim for the reasons set forth in the discussion of Claims 4, 5, 6, 7, and 8 above.

Conclusion

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Wesley D Markham whose telephone number is (571) 272-1422. The examiner can normally be reached on Monday - Friday, 8:00 AM to 4:30 PM.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Shrive Beck can be reached on (571) 272-1415. The fax phone number for the organization where this application or proceeding is assigned is 703-872-9306.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

Wesley D Markham
Examiner
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